

WHAT IS CLAIMED IS:

1. A method for Viterbi decoding comprising:
 - receiving a sampled signal;
 - making a hard decision on which constellation point the sampled signal represents thereby creating a hard decision point;
 - determining a scaling factor (k) corresponding to the hard decision point; and
 - providing the scaling factor (k) and the hard decision to a Viterbi decoder
2. The method as in claim 1 wherein making a hard decision on which constellation point the sampled signal represents comprises choosing a constellation point which is the closest Euclidean distance to the received sample signal.
3. The method of claim 1 wherein determining a scaling factor (k) corresponding to the hard decision comprises:
 - selecting a first constellation point corresponding to the hard decision point;
 - determining a second constellation point corresponding to a nearest constellation point having the designated received bit; and
 - assigning a scaling factor value dependent on the number of constellation points between the first constellation point and the second constellation point.

1
4. The method as in claim 3 wherein comparing the designated received
bit to the hard decision to compute the scaling factor comprises reading the scaling
5 factor from a look up table.

5. The method of claim 4 wherein reading the scaling factor from a look
up table further comprises:

10 using the designated received bit and the hard decision to index into a
look up table; and
reading the scaling factor from the look up table.

15 6. The method as in claim 3 wherein comparing the designated received
bit to the hard decision to compute the scaling factor comprises:

selecting a transition for which the scaling factor will be determined,
thereby determining a selected transition;

20 determining a designated received bit that will result in the selected
transition; and

25 comparing the designated received bit to the hard decision to compute
the scaling factor.

7. The method of claim 6 wherein assigning a scaling factor dependent
on the number of constellation points between the first constellation point and the
30 second constellation point comprises:

assigning a value of zero to the scaling factor if the first constellation
point is equal to the second constellation point;

35 assigning a value of 1 if the first constellation point is adjacent to the
second constellation point; and

1 assigning a value of $2N+1$ if the first constellation point is separated
from the second constellation point by N constellation points.

5 8. The method as in claim 1 wherein determining a scaling factor (k)
corresponding to the hard decision point further comprises:
determining a first scaling factor dependent on the location information
10 of the hard decision;
determining a second scaling factor dependent on the signal to noise
ratio of the channel; and
combining the first scaling factor with the second scaling factor to
15 produce the scaling factor k .

20 9. An apparatus for decoding a signal, the apparatus comprising:
means for receiving a sampled signal;
means for making a hard decision on which constellation point the
sampled signal represents;
means for determining a scaling factor (k) corresponding to the hard
25 decision points; and
means for providing the scaling factor (k) and the hard decision to a
Viterbi decoder.

30 10. The method of claim 8 wherein the means for determining the scaling
factor (k) corresponding to the hard decision point further comprises:
means for determining a first scaling factor dependent on the location
information of the hard decision;
35

1 means for determining a second scaling factor dependent on the signal
to noise ratio of the channel; and

5 means for multiplying the first scaling factor to the second scaling
factor to produce the scaling factor (k).

11. A method of signal decoding comprising:
10 accepting a received signal;
quantizing the received signal to a point in a signal constellation plane,
to provide a quantized point;
15 making a hard decision as to which constellation point the quantized
point represents;
determining scaling factors (k's) associated with each constellation
point;
20 using the scaling factors and hard decision point to determine decoder
metrics; and
providing a decoder metrics and quantized point to a Viterbi decoder.

25 12. The method of claim 11 wherein making a hard decision as to which
constellation point the quantized point represents comprises:
determining which constellation point is closest to the quantized point;
and
30 assigning a value of the nearest constellation point to the quantized
point.

35 13. The method of claim 12 wherein determining which constellation point
is closest to the quantized point comprises:

1
computing a Euclidean distance squared between the quantized point
and the candidate constellation point; and

5 selecting the constellation point with the smallest Euclidean distance
squared as the closest constellation point.

10 14. The method as in claim 13 wherein selecting the constellation point
with a smallest Euclidean distance squared comprises:

(a) squaring an X direction distance between the quantized point
and the candidate constellation point to provide a squared X direction distance;

15 (b) squaring a Y direction distance between the quantized point and
the candidate constellation point to provide a squared Y direction distance;

(c) adding the squared X direction distance to the squared Y
direction distance to find a Euclidean distance squared;

20 (d) repeating steps a, b and c for all candidate points;

(e) selecting the candidate point with a smallest Euclidean distance
squared.

25 15. The method as in claim 11 wherein determining the scaling factors
associated with each quantized point comprises:

determining an amount of noise necessary to create an error in a
candidate bit; and

30 assigning the scaling factor in proportion to the amount of noise
necessary to create an error in a candidate bit.

35 16. The method of claim 11 further comprising:

1 multiplying the scaling factors times a signal to noise ratio (SNR)
scaling factor to provide a scaled SNR result; and
5 using the scaled SNR result to determine the decoder metrics.

17. The method of claim 16 wherein using the scaled SNR result to
determine the decoder metrics comprises:

10 using the results as an index into a branch metric table; and
reading the metric associated with the index.

18. An apparatus comprising:
15 an input for accepting a received signal;
a quantizer that accepts the received signal from the input and
quantizes the input to a point in a signal constellation plane, to provide a quantized
point;
20 a hard decision unit that accepts the quantized point and determines a
constellation point that the quantized point represents;
a scaling factor unit that determines scaling factors associated with the
25 constellation point; and
a metric calculator that accepts the scaling factors and the
constellation points and determines branch metrics for the constellation points.

30 19. An apparatus of claim 18 further comprising:
a Viterbi decoder that accepts the constellation points and the branch
metrics and produces decoded bits.

35 20. The apparatus of claim 18 wherein the metric calculator comprises:

1

an input that accepts a signal to noise ratio (SNR);

an input that accepts scaling factors; and

5

a combination circuit that combines the scaling factors and SNR to
create a branch metric.

10

15

20

25

30

35